THE INCREDIBLE INVENTIONS OF TONY CUTHBERT

Could Tony Cuthbert, a gifted and prolific inventor with serious dyslexia, be the new Edison of the 21st century?

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One Monday morning recently, Tony Cuthbert woke up in his remote Welsh cottage and went to his battered Pentium 2 laptop in the corner of the bedroom. Typing slowly, key by key, he tapped out: "Hear is an inventoin for a new chuck deavice, using an aloy with a low liuqifactoin temperature [*sic*]."

Inventors normally guard their ideas jealously, and try to patent them before talking about them, but Tony doesn't care who knows about Monday's little inspiration. "Having new ideas isn't a problem for me. I come up with at least one moderately interesting invention every day and a really good one about once a week." He says it completely without arrogance and with a touch of surprise, as if talking about someone else. "It may be something to do with my dyslexia, but I seem to think differently from other people."

At the age of 54, Tony can't remember how many bright, technological ideas he has had, but he reckons they must run into "many thousands"—most of which he says he has forgotten.

Michael Laughton, Professor of Electrical Engineering at London University, who has spent the last decade informally scouring Britain for out-of-the-way inventors, says Cuthbert is unique. "Tony is the most prolific and gifted inventor I have come across. Given the right kind of backing, he could easily surpass Edison's record of a thousand patents."

The rewards of technological creativity are notoriously fickle and often illogical: the inventor of a complex vacuum cleaner has earned a few million, but a simple cardboard milk carton has made someone else a billionaire. If there were any justice in the world of invention, Tony Cuthbert would now be a multi-millionaire, too—for his new clutchless gearbox and brake system alone. But then there's also the Cuthbert turbine, the Cuthbert magnetic separator, the Cuthbert Rain Enhancer, Cuthbert sub-sea ice technology—and a couple of free-energy devices as well. And yet he has only his disability pension on which to live.

"One of Tony's problems is that some of his inventions are so revolutionary that they can threaten existing technologies," says Professor Laughton. "That makes it difficult for him to convince the various industries he has tried to interest." James Dyson had precisely this problem with his vacuum cleaners, and finally ended up having to manufacture the machines himself. But Cuthbert is not in the entrepreneur mould. "I know it's my fault," he admits disarmingly. "Dyson succeeded because he has a one-track mind and was able to focus his energies on one invention, but I have so many different ideas at once that so far I haven't concentrated on any one of them long enough."

At school, Cuthbert had been the classic classroom dunce. Profoundly dyslexic before the word had been coined, he was bottom of the class in everything except science. "More suitable for manual labour than mental work" said his final report when he left his Liverpool school at the age of fifteen. He began work as a garage hand, then joined the merchant navy as an engine boy. He was then eighteen. Within two years, he had risen to the rank of Chief Electrician—one of the youngest in the whole merchant fleet. "I had no formal training at all, but I seemed to instinctively understand how things worked. Whenever there were any electrical problems on board, I somehow just knew how to fix them. That's how I got the job so young," he says.

He stayed with the merchant navy for 20 years, ending up overseeing the electrical installations on new merchant ships built in Poland and Finland. Severe arthritis forced him into early retirement at the age of thirty-seven. But, despite illness, he found his mind bubbling with ideas, so he set up his own consultancy. Word of mouth in the mid-Wales

countryside quickly made him famous as a local Mr Fixit. "If a firm had a technical problem, I found I could normally offer them two or three solutions within a couple of days", he says.

Eventually, word about Cuthbert reached as far as Aberdeen, Scotland, where the mighty Shell Oil picked his brains on how to deal with their Brent Spar oil platform problem. After environmentalists had forced the company to abandon their initial proposal to sink the Spar in the North Sea, Shell had decided to float the platform and bring it ashore for dismantling, and were looking for the best way to do it. Cuthbert showed them how they could freeze the seawater around the rig to strengthen and seal the structure, and then pump out the water to float it on its side, ready for towing. Although Shell finally used a more conventional flotation technique, they had taken the ice idea seriously. "Cuthbert's ideas certainly had merit," recalls Eric Fowlds of Shell.

A HYBRID TURBINE/ENGINE

Oil platform problems one day, engines the next. Small-time inventors are fond of engines—they have lots of little bits to improve on—but eight years ago Cuthbert had more than tinkering refinements in mind. "I realised nobody had made a new engine for a hundred years, apart from Wankel; he was a brilliant inventor, but even *his* engine has problems," says Cuthbert. "So I decided to try and re-design the perfect engine from scratch."

It took him six months to come up with something that would satisfy him. Early in 1993, he sent the drawings to the giant Perkins Diesel company who invited him to make a presentation to their chief technical designers. It was a bold, unique concept that was a hybrid of a conventional engine and a turbine. The power generation system was incorporated inside the turbine itself, with the rotation being provided by a clever waveform shape of the turbine discs. Cuthbert explained how, according to his calculations, the hybrid engine should have "incredible power", enabling an ocean liner to be run by an engine the size of a Mini car.

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Perkins' designers were impressed, calling it a "novel and simple concept which offers potential", and eagerly suggested "moving the concept forward into a working model". Two months later, however, they suddenly went cold on the idea, cancelling all further meetings. Cuthbert rang to ask why. "Perkins apologised profusely," he recalls, "but said that their financiers had advised them to drop my turbine as it would be 'detrimental' to their business. I guess it was too much of a competitor to their existing range of turbines."

The money men also appeared to be behind Cuthbert's next failed attempt to interest big business. He took the hybrid turbine/engine idea to Cray Marine, the large British defence contractor, who seemed to be as impressed as Perkins by the concept and went so far as to calculate the engine's potential output. They confirmed Cuthbert's own figures, showing it should develop at least 10 times more power than existing turbines. Cray were keen to develop the concept into a working prototype, but not without external finance. However, they couldn't find a venture capital bank to back it. "Time was the deciding factor; the one bank that showed interest wanted a quick capital return," says Cuthbert, ruefully.

But time is now running out for Cuthbert himself. Desperate to find a backer for his turbine, he has decided on a high-risk strategy. In order to attract investment, he has published the technology on the Internet, but without the protection of a full patent; he has only been able to afford a limited patent for one year—and the patent has just a few months left to run.

NEW APPLICATIONS FOR FERROFLUIDS

In the meantime, Cuthbert's bedroom is knee-deep in drawings for a new invention for the scrap metal industry. This time, the idea came to him "in a few days", after Shell had introduced him to Britain's leading scrap metal company, Mayer Parry Recycling. Impressed by his inventiveness, Mayer Parry then showed him round their huge metal reclamation plant, hoping to pick his brains.

"I was very impressed by the Mayer Parry operation, but I could see several areas where I could suggest improvements," says Cuthbert. "They asked me to come up with some ideas, and I gave them three suggestions, one of which was a metal separation technique based on ferrofluid—a magnetic liquid."

Back in his workshop, he happened to have a bottle of ferrofluid left over from some long-forgotten experiment. First developed for NASA in the 1960s, ferrofluids are tiny, magnetised metal particles in an oil suspension. They have now found uses in a variety of specialised applications, from loudspeakers to rotary seals—but in relatively small quantities. Cuthbert had half a jar of the stuff and immediately set to work, testing it with whatever bits of metal he had to hand.

Mayer Parry bosses saw the resulting demonstration—literally in one of Cuthbert's old teacups—and shortly afterwards commissioned him to present a design for an industrial-sized metal separator. Within weeks he had come up with a system, and a small-scale prototype was built. In November 1999, in conditions of great secrecy, the ferrofluid separator was started up—and it worked.

"Cuthbert's metal separator is a very, very significant advance," says Mike Glossop, who runs the UK division of Ferrofluidics, Inc., the world's leading manufacturer of ferrofluids. "Cuthbert is the first person to have invented a workable metal reclamation system using liquid magnets. This is a real breakthrough."

Cheap, efficient, metal reclamation has obvious environmental benefits, particularly in Britain where landfill sites for waste are becoming scarce. But Glossop also foresees the Cuthbert separator revolutionising the mining industries, making it far cheaper to extract precious metals from crude ores.

Although Cuthbert is happy enough with the prototype separator, he has since thought of an even better way of doing it. So he is now designing a top-secret Mark 2 version, based on an entirely different principle. Mayer Parry has earmarked £500,000 for it.

But, with a mind like Tony Cuthbert's, playing about with any new material is bound to set off a chain reaction of inventiveness—and ferrofluids have done just that. "Magnetic liquid is really weird stuff," he says excitedly, "so I knew there was bound to be lots more to do with it." Sure enough, whilst buried in the details of his magnetic separators, he was able to came up with a fistful of applications. Understandably, given his

naval background, his first ideas were for ships. Very soon, he had a revolutionary marine propulsion concept using ferrofluids. Again, he can't afford to patent the idea, but is happy to explain it to anyone who will listen.

"Magnetise the hull of a ship. Take a few hundred litres of ferrofluid and stick it to the hull. Being superparamagnetic, it will naturally form itself into a thick film on the surface of the hull. The trick to turn it into a propulsion system is to put a magnet on a track just inside the hull and move the magnet from prow to stern." He does a rough sketch of a ship and draws a fin-like shape on the hull opposite the magnet. "The magnetic field will create a bump on the side of the ship, and by altering the field I can make a bump of any shape I want—like a fin or an oar. If I move the magnet sternwards inside the hull, the bump will travel down the ship and propel the ship forward. Obviously, in a real application you wouldn't move a magnet; you'd use a solid-state linear motor. That would let you have multiple bumps along the hull and make it a continuous process—like the fins on a fish, only much more efficient, with hundreds of them."

Never one to come up with an idea without testing it, Cuthbert built a small-scale prototype, using a tin can, an electric motor, a piece of string, a pulley and a child's magnet. He put the contraption in his bath "and it went 'zzhipp' through the water". "That was a useful one-day project," he adds.

The following day he was down at the butcher's, buying a cow's heart. He wanted to try out another off-the-wall application for magnetic liquid—in cardiac medicine. "Existing artificial hearts are very complicated things with lots of moving parts which can get clogged up," he says, "so I wondered: how about using ferrofluids to power a real heart?" He picked up the inert lump of cow's heart and injected ferrofluid into the muscle. He placed a rotating magnet next to it and the heart started pumping. He is clearly proud of having invented something with the potential to save lives. "Imagine, you could have an artificial heart made of real heart tissue which would never clog up," he says, "or you could inject a damaged heart and encourage the muscle to regenerate."

In theory, this should be a constantly self-propelling, free-running system—"not a perpetual motion machine, an idea which would send any reasonable scientist running for cover," he is quick to point out, "but a device to extract usable energy from Earth's gravitational field."

CUTHBERT'S GRAVITY ENGINE

Mike Glossop of Ferrofluidics has a soft spot for Cuthbert. "Many people Tony meets think he's a bit like a mad professor. I might use the same term myself, but I would use it as a term of endearment rather than [in the sense] that he's some sort of loony tune. He's a combination of an old-fashioned type of experimental physicist and an extraordinary lateral thinker. Ideas come out of him in torrents. It is possible many of them will be disproved. But I've got too much respect for him to dismiss any of them out of hand."

Glossop admits recently losing a small, friendly bet with Tony over an idea that he felt couldn't possibly work. Cuthbert proposed used ferrofluids as a sort of vertical magnetic track. Paint a wall with a strip of liquid magnetic paint, he said, and it could be used as a track to take firehoses up skyscrapers, or even as a fire escape route. Glossop was sceptical and bet him it wouldn't work. But within two days, Cuthbert had the demonstration. He stuck magnets onto the caterpillar tracks of a wind-up toy tractor, and painted ferrofluid up a wall. The tractor climbed the wall with ease. "It was the nicest £100 I ever parted with," says Glossop.

Last year, however, much more of his money went to finance another Cuthbert idea, even though most conventional engineers would rate it on the loony tunes scale as highly melodious. Cuthbert calls it the Gravity Engine.

"Ever since my days in the navy, I've always been interested in getting power for nothing," says Cuthbert. "I know theoretically it's impossible because of the law of conservation of energy, but there are always ways round things."

He had built lots of over-unity devices in the previous 20 years, based on various principles, but without success.

"When I started observing the strange properties of ferrofluids, something clicked," he recalls. "It suddenly occurred to me that, with ferrofluids, the source of power for a free-energy machine could now, probably for the first time ever, be gravity."

There were two key insights behind Cuthbert's creative leap. The first is simple; in fact, any child playing in the bath knows it. Solid objects appear to be heavier in air than in water, and hollow objects are lighter in water than in air. As every schoolkid knows, it is the fact that water is denser than air that is responsible for these everyday phenomena. But what few of us would have the vision to realise is that in a friction-free universe this could be exploited to make a "gravity engine".

Cuthbert's second insight came while "playing about" with ferrofluid for his experimental metal separator idea. He discovered that magnetic liquid could be held in a hollow tube by surrounding it with a magnetic field, and that this would in turn support a whole column of water above. Poking a pencil up through the magnetic liquid into the water, he was surprised to discover that the pencil went in very easily and yet the ferrofluid seal was so tight that not a drop of water escaped.

In a flash, Cuthbert put insights one and two together, and the Gravity Engine was born. He saw that, with ferrofluid acting as the interface between water and air, he could pass a hollow ball up into the water from below, let it float to the surface, drop it down through air and reintroduce it into the water. In theory, this should be a constantly self-propelling, free-running system—"not a perpetual motion machine, an idea which would send any reasonable scientist running for cover," he is quick to point out, "but a device to extract usable energy from Earth's gravitational field. In its crudest form, a series of balls on a string should be able to go endlessly round and round, powered by the difference between the density of water and air. It's easiest to imagine it working with balls that float in water, but balls of any density should produce the same result."

Cuthbert knew the problem was going to be whether the energy produced by the system would be enough to pull the balls through the ferrofluid seal. He decided to put it to the test in an

experiment, and constructed a crude device out of a glass column, half a pint of ferrofluid and two lead balls on a piece of string. To his surprise, it appeared to work—but he knew that before pursuing the idea any further, he had to do some real science; in particular, he needed some hard data on the boundary layer properties of ferrofluids.

Cuthbert mentioned it the next time he talked to Ferrofluidics. "I am only after the principle at the moment," he told MD Mike Glossop. "All I'm saying is, 'Look at this; this is weird.'"

Glossop responded by funding a mini research project under the aegis of a leading ferrofluids expert. Such people are pretty thin on the ground, but, as it happened, a German physicist-engineer, Dr Wolf Fruh, had just taken up a research fellowship at Heriot-Watt University in Edinburgh, Scotland; he was working on a ferrofluid project for the gas and oil industry.

Thus it was that, early in 1999, Cuthbert found himself driving his 15-year-old Vauxhall Carlton the 600 miles from Wales to Scotland. Fruh, the university-educated theoretician, and Cuthbert, the self-taught experimental physicist, were an ideal combination, although Fruh was initially highly sceptical. "The second law of thermodynamics says perpetual motion machines can't exist," he told Cuthbert firmly at the outset.

Cuthbert and Fruh decided to test the Gravity Engine concept using balls made of polystyrene foam on a length of string, so it was barely more sophisticated than Cuthbert's own first set-up. However, to Fruh's astonishment, it worked.

"I made one rig over the summer and tried one of Tony's experiments, and proved that he was correct," said Fruh. "We managed to repeat his finding that a number of floating balls in the water column will pull another ball through the magnetic liquid seal, overcoming the resistance it encounters when entering the ferrofluid." But he remains sceptical that he has witnessed an embryonic perpetual motion machine. "It's quite an interesting result," says Fruh, "but you cannot conclude that you could do anything useful with it."

Naturally, Cuthbert himself is much less pessimistic. "The Gravity Engine isn't a perpetual motion machine. It's just a device to extract energy from Earth's gravity field. In that respect, it's no different from a water wheel," he says. "The next step is to find some funding to make a decent experimental rig."

What made the company scientists sit up and stare at Cuthbert's tape in disbelief was this: they saw a machine that moved forward in mid-air, and yet was powered by neither rocketry nor any other form of external thrust.

A FASTER-THAN-LIGHT PROPULSION SYSTEM?

In the meantime, while waiting for the right sugar-daddy to come along, Cuthbert has been working on yet another scientifically "impossible" device. This one appears to break another scientific canon—Newton's third law, which says that "action and reaction are equal and opposite". The force of a rocket going upwards is equal to the force of the rocket gases going downwards, in the same way as the force of a car going forward is equal to the force of the tyres trying to push the road backwards. But Cuthbert is in the Michael Faraday tradition of experimental scientists, for whom theory must always take second place to experiment.

One day, while playing around with some weights, Cuthbert saw something that made him wonder whether there might be a way around Newton's third law. Three months later, he had a test device. He videoed it working and took the tape to the advanced projects division of one of Britain's leading defence companies. "We'll look at it on condition you mention our meeting to nobody," the company told him. "If it were known that we were interested in this sort of paranormal stuff, our share price might plummet."

What made the company scientists sit up and stare at Cuthbert's tape in disbelief was this: they saw a machine that moved forward in mid-air, and yet was powered by neither rocketry nor any other form of external thrust. The contraption Cuthbert showed them was so crude, it could have come out of the pages of Rube Goldberg or Heath Robinson.

Reluctant to disclose too much before the thing is patented, Cuthbert describes it like this: "The device can be best described at this time as a rotary-to-linear conversion effect utilising the angular velocity of mass. However, the effect generated is not directly gyroscopic."

At first, the company scientists thought that they were seeing a simple "ratcheting" effect, where a vigorous thrust backwards will propel the device forward, but friction will prevent it going backwards during the return cycle. However, Cuthbert already knew about this ratcheting effect and had eliminated it.

To do that, he bolted the device to a metal plate and suspended it on an "air table"—a surface peppered with tiny holes through which jets of air are pumped. Nevertheless, even on this totally frictionless surface, the device still moves forward. And that is what has puzzled the defence company scientists who have seen it, and has prompted them to give Cuthbert limited finance to develop the idea further. "It is probably some kind of unknown ratcheting effect," they told Cuthbert, "but if it isn't, we want to know what's going on."

The stakes could be high. The defence contractor sees its potential as a possible satellite propulsion system, but Cuthbert's mind has already jumped far ahead. "If I am right and inertia can be eliminated, perhaps it will be able to travel beyond the speed of light," he says. "I think I already know how to modify inertia in an electro-mechanical model, but my ultimate goal is a solid-state device."

Cuthbert has already designed it. "The technique uses very-high-speed switching circuitry, and will probably involve laser or microwave radiation," he explains to gobsmacked potential backers. A university department of engineering is already taking the concept seriously enough to check the mathematics behind it.

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MORE INVENTIONS AND INNOVATIONS

Meanwhile, Cuthbert's current mission is to follow up an initial spark of interest from DERA (the UK equivalent of the US Defense Advanced Research Projects Agency, or DARPA) in his clutchless gearbox/brake system. It's yet another stunningly inventive concept, which again he cannot afford to patent. The potential rewards are so high that he dare not let the secret out, and a mere mention of its principle in these pages would put it in the public domain and lose him his intellectual property rights forever. The same goes for his Rainfall Enhancer, which he successfully demonstrated last week in his bath, using salt water, floating balls and a floodlight. But that's probably already saying too much.

Keeping body and soul together—let alone protecting patents—while at the same time doing innovative science is the eternally painful way of life of most small-time inventors. They must endure a classic double-bind: they're too brilliant and eccentric to be conventionally employable, but lack the entrepreneurial skills to fund the fruits of their inventiveness.

Like composers and artists of the past, 21st-century inventors need patrons. At present, Cuthbert's most powerful supporter is Michael Laughton, Professor of Electrical Engineering at London University and a member of a major UK Government energy advisory committee; he is doing his best to put the struggling inventor in touch with anyone who can help.

Part of Professor Laughton's motivation is sheer Christian charity, but there's also a more fundamental message he wants to convey to his academic colleagues. "The industrial revolution happened because of craftsmen-inventors like Tony Cuthbert, James Dyson and the inventor of clockwork radio, Trevor Bayliss," Laughton points out. "It did not spring from the minds of university-educated people. For too long have we worshipped at the altar of paper qualifications to the exclusion of a wider view. We must recognise the enormous value of the true innovator in effecting the technical changes in society which create real wealth."

In February of this year, Cuthbert's luck stopped running out. He got a phone call to say that "someone big" was interested in his turbine.

"I can't tell you who it is, because I have signed a confidentiality agreement," he apologises, "but let's just say that a branch of the British Government has provided the funds to build and test a 'proof of principle' prototype. And that particular version of the turbine will be fully covered by patents, I can assure you." ∞

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Tony Edwards is an award-winning British television producer and writer on science and medicine. He is best known for his 1994 BBC series, *Heretic*—film portraits of six contemporary scientists who fell foul of the scientific establishment for their 'dissident' research. He is at present directing a mini-series for the Discovery Channel on the current international race to build the biggest and highest-flying airships ever. He can be contacted by e-mail at tony.edwards@ir.clara.net.

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